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Hasunuma

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(54) **KEYBOARD**

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(51) **Int. Cl.**[7] **H01H 13/70**

(52) **U.S. Cl.** .... **200/5 A**; 200/512; 200/341; 400/491

(58) **Field of Search** .... 200/5 A, 513, 200/517, 344, 341, 512; 400/491, 491.2, 495, 495.1, 496

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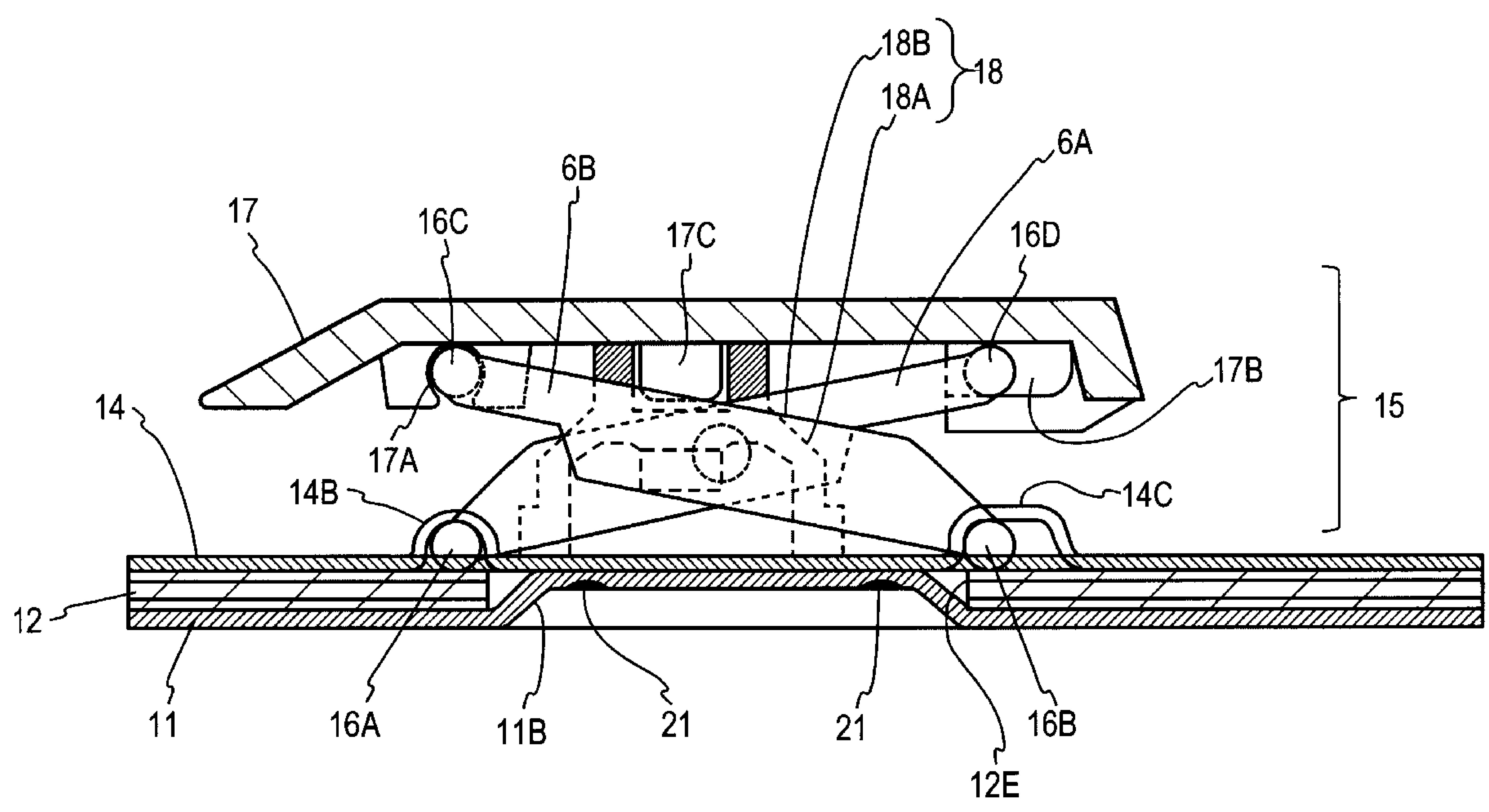
(57) **ABSTRACT**

In a keyboard that comprises a membrane switch sheet having switch portions arranged all over it, a keyboard substrate and a keyboard frame having sandwiched therebetween the membrane switch sheet to provide therein rigidity, and actuators for ON/OFF control of the switch portions through openings made in the keyboard frame, the keyboard substrate and the keyboard frame are each formed by a thin aluminum sheet, the membrane switch sheet has plural through holes, and plural trapezoidal bumps or protrusions formed by stamping the keyboard substrate toward the keyboard frame are inserted through the plural through holes into surface-to-surface contact with the keyboard frame, the plural trapezoidal bumps being spot-welded in their flat top surfaces to the keyboard frame.

10 Claims, 9 Drawing Sheets



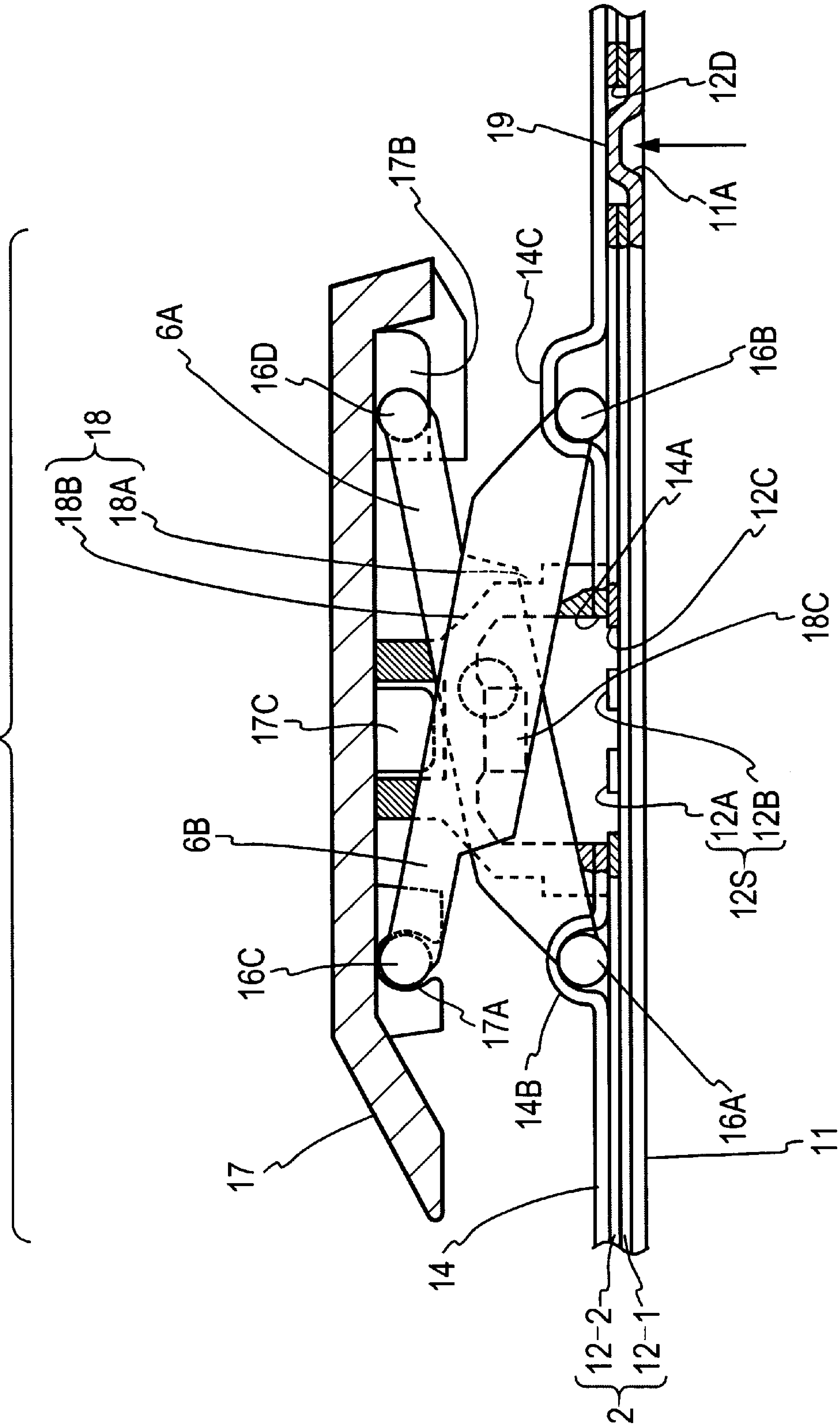


FIG. 1
PRIOR ART

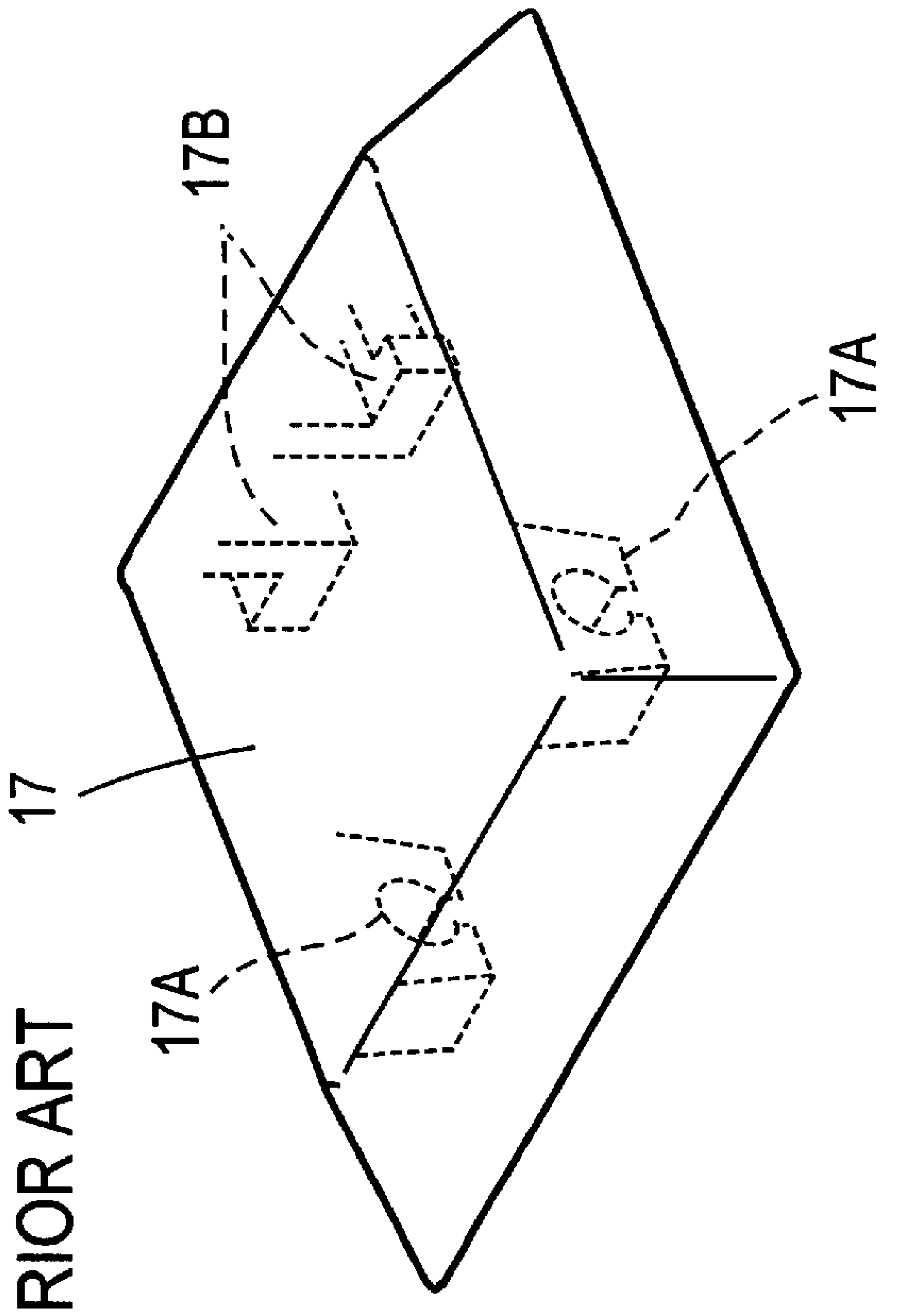


FIG. 2B
PRIOR ART

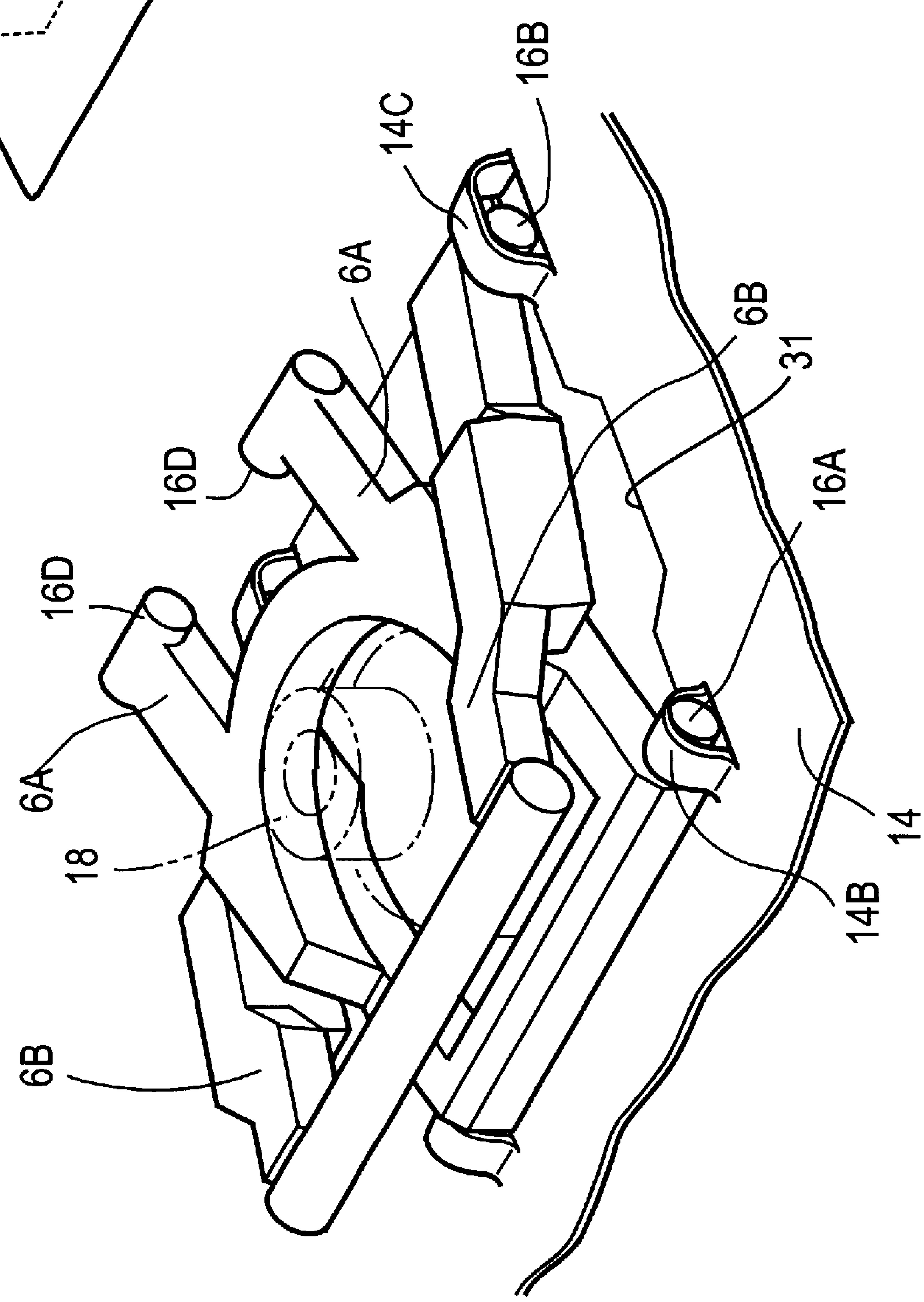


FIG. 2A
PRIOR ART

FIG. 3A

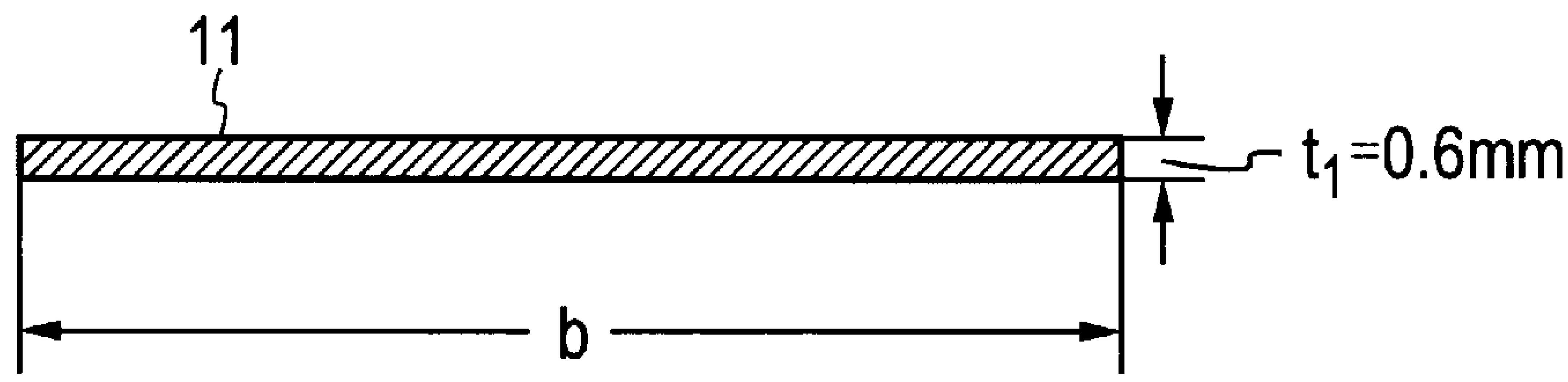


FIG. 3B

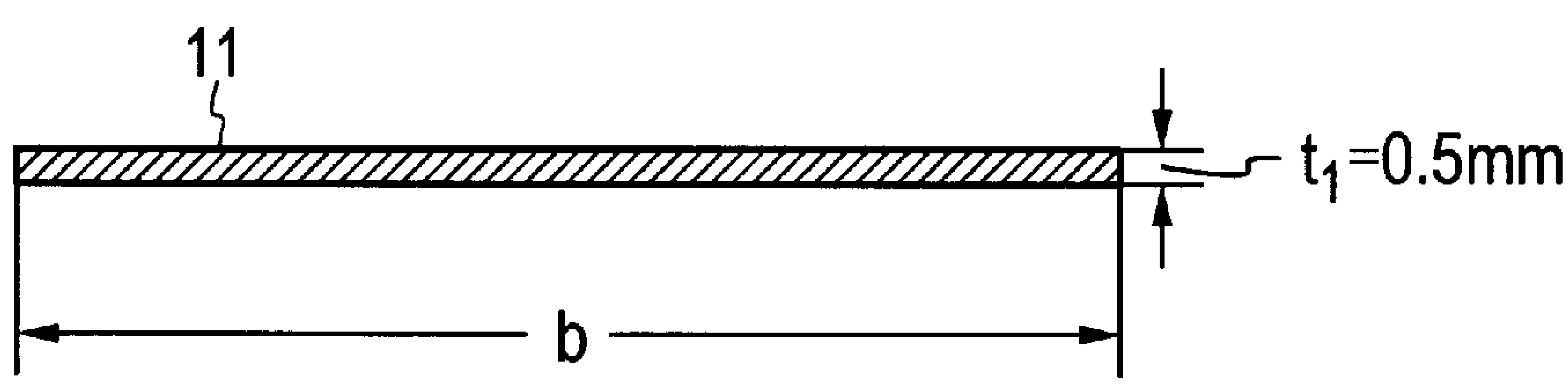
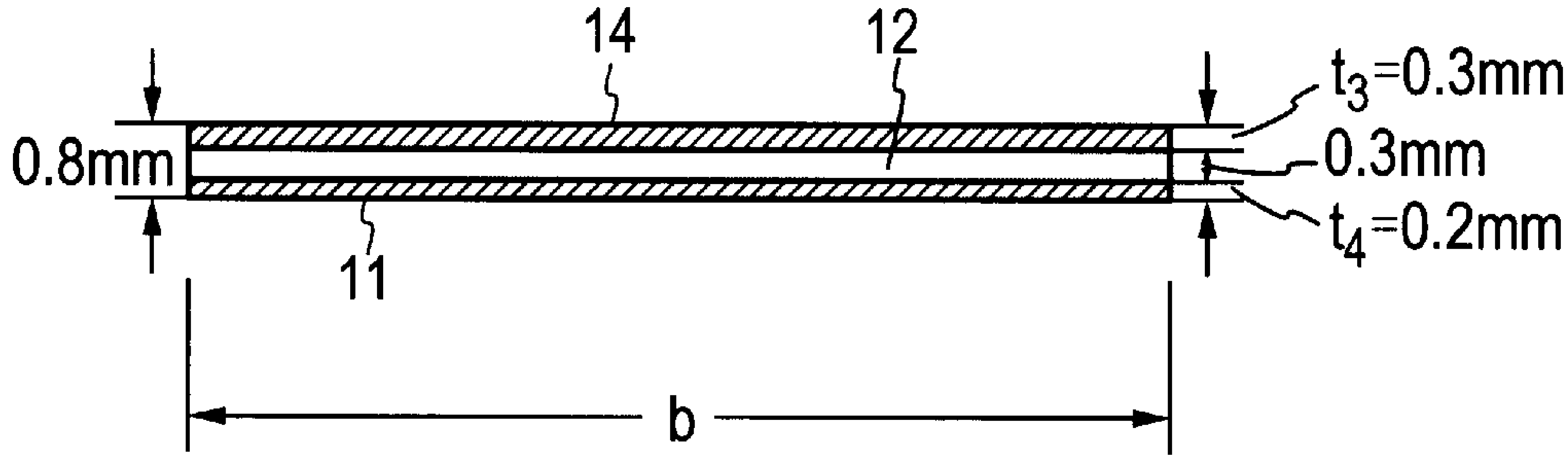


FIG. 3C



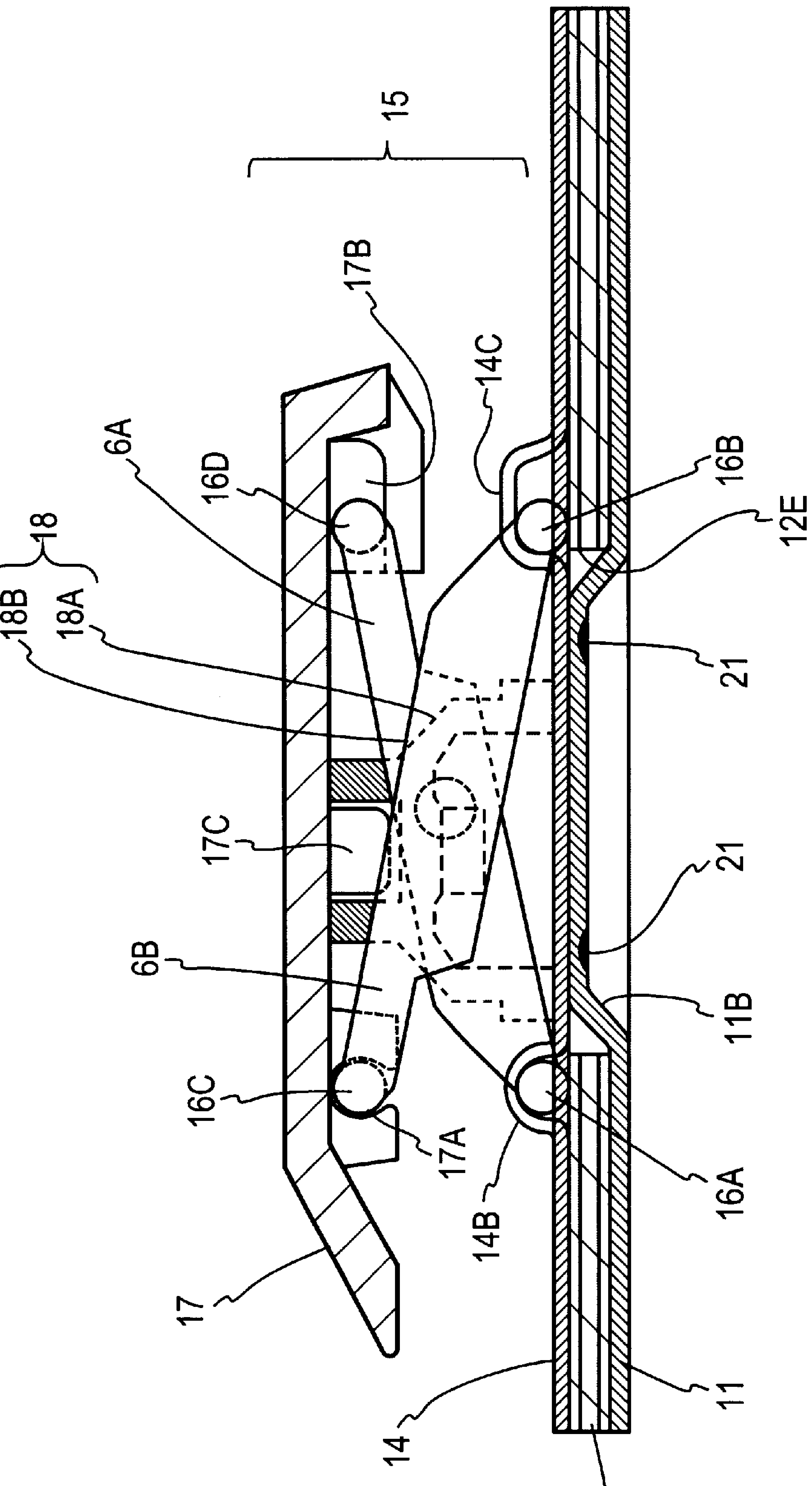

15
17B
14C
6A
16D
16B
12E
18
18B
18A
21
17C
21
6B
11B
16C
17A
16A
14B
17
14
11
12

FIG. 4

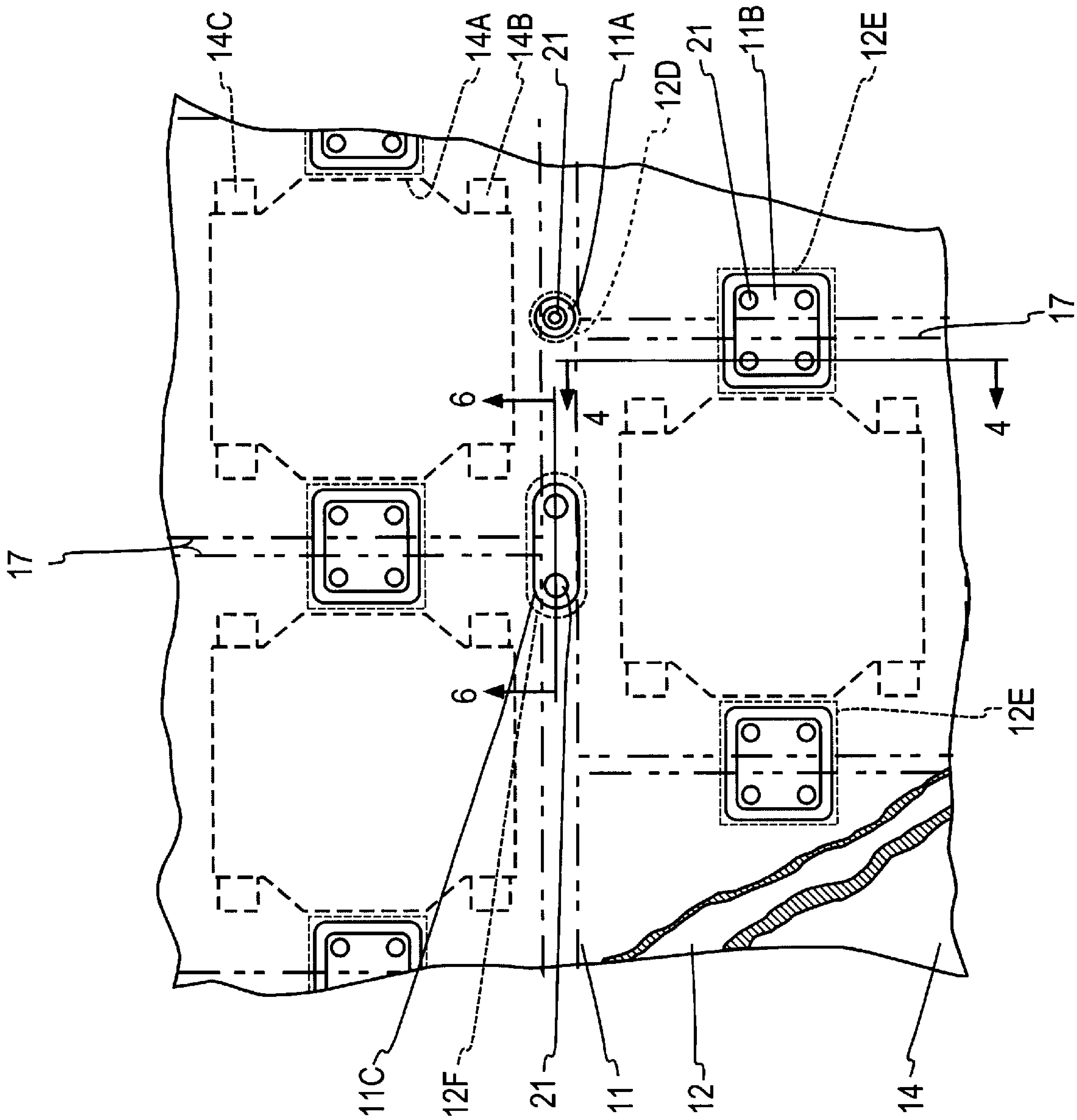

14C
14A
14B
21
11A
12D
21
11B
12E
17
6
4
4
17
6
12E
11C
12F
21
11
12
14

FIG. 5

FIG. 6

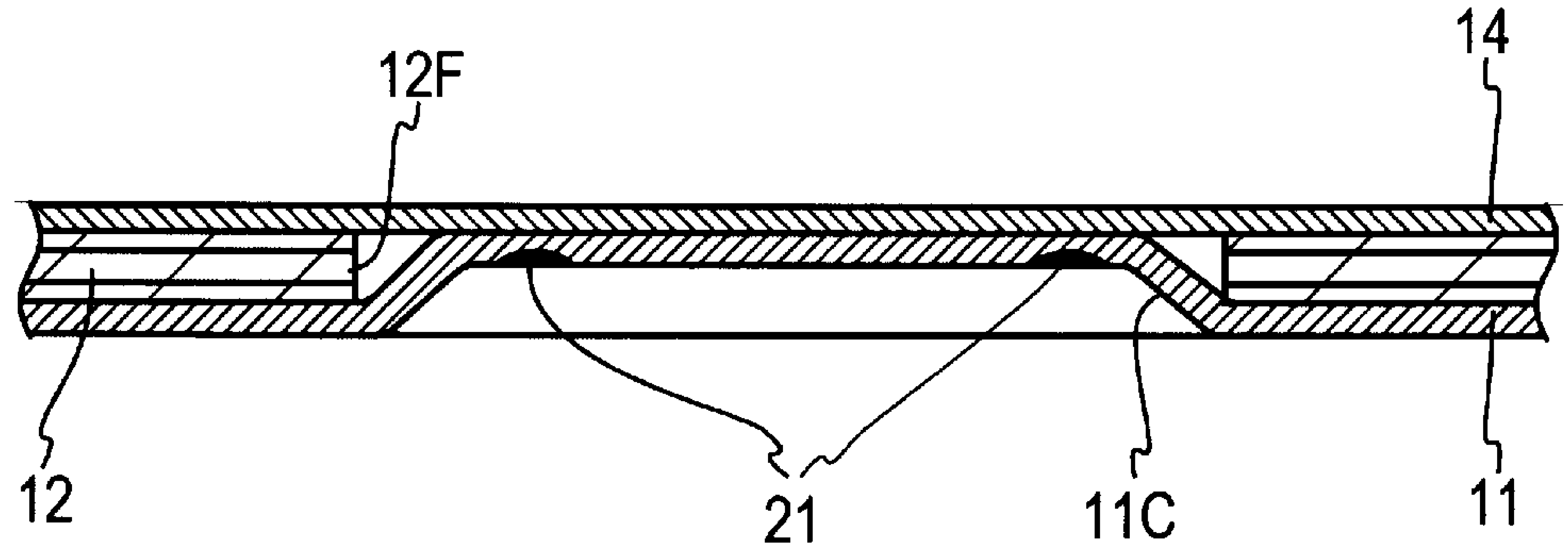
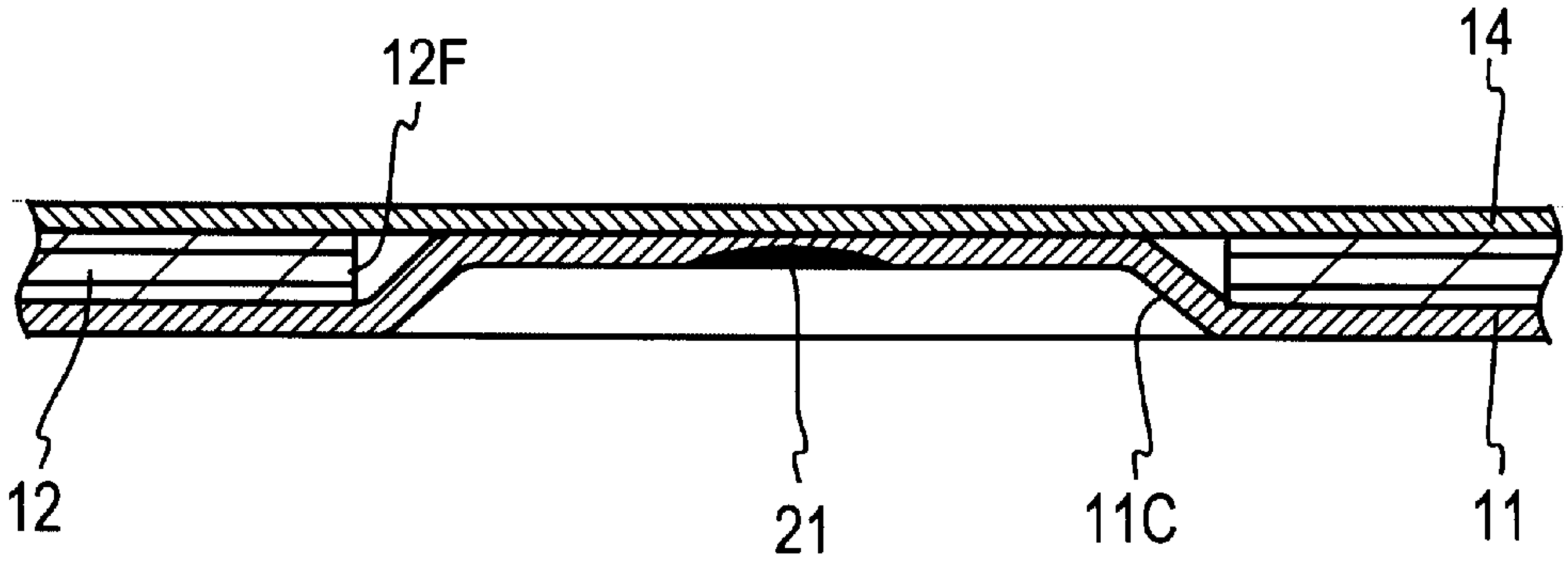


FIG. 7



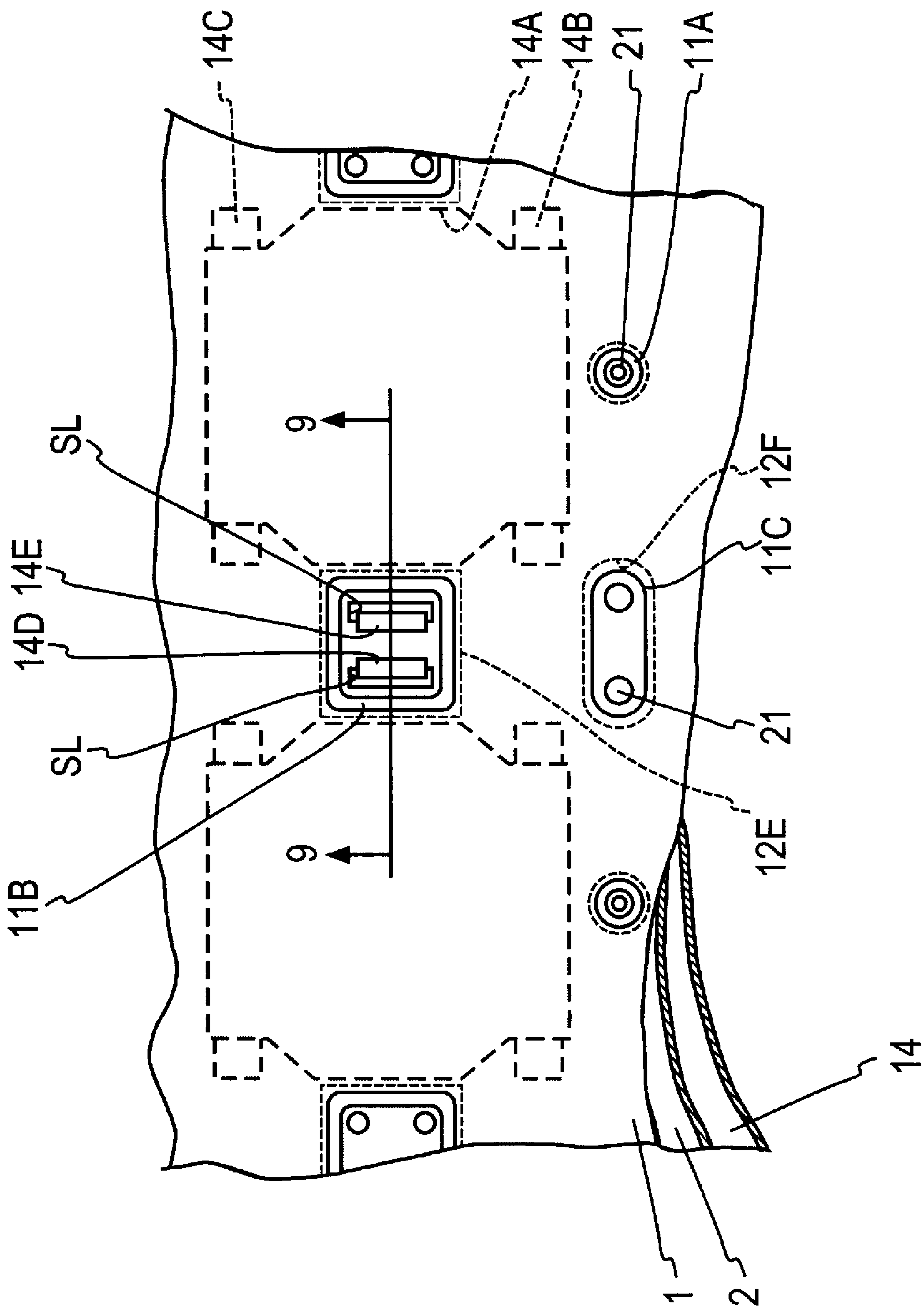


FIG. 8

FIG. 9

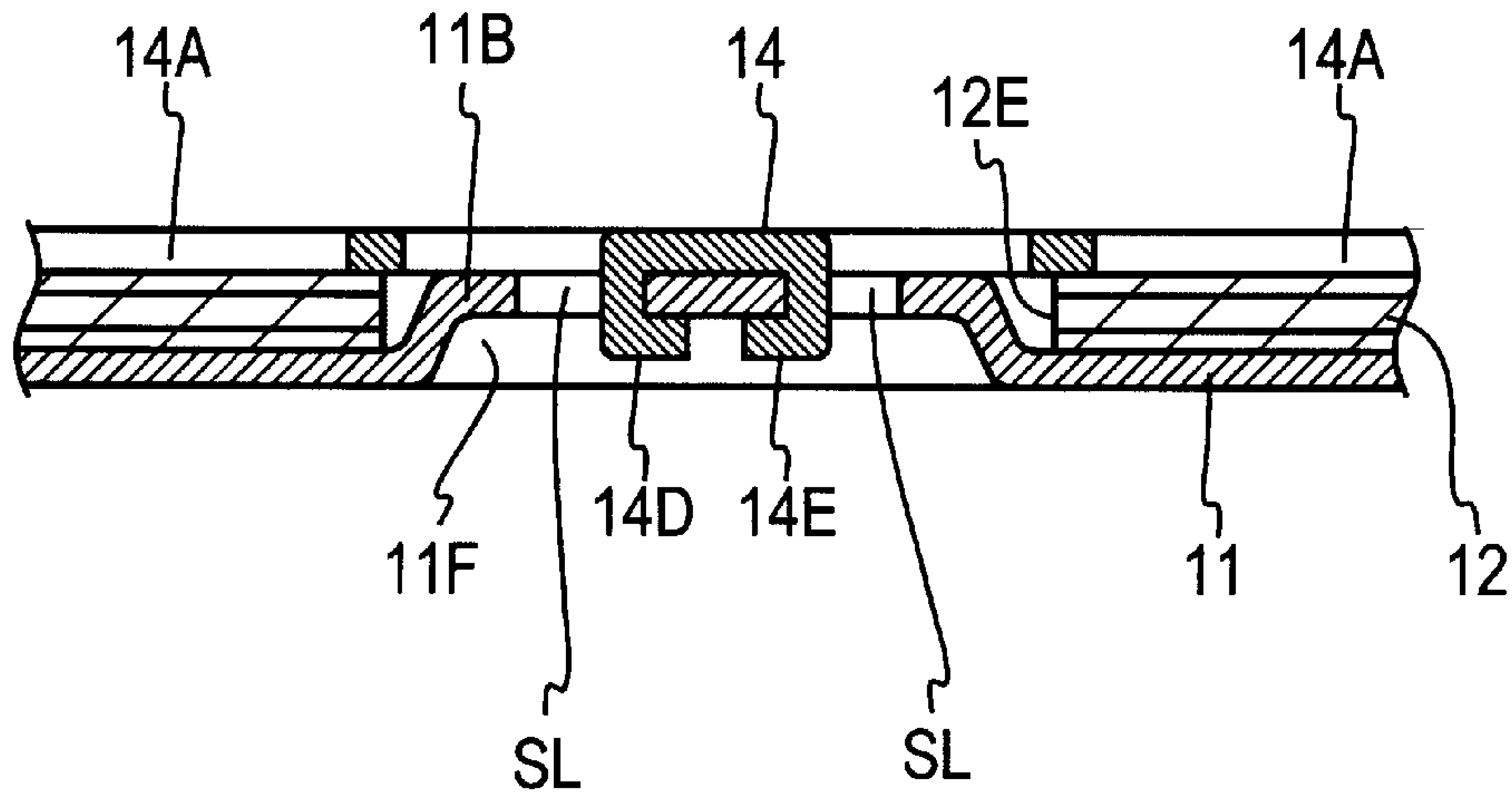

14A
11B
14
12E
14A
11F
14D
14E
11
12
SL
SL

FIG. 10

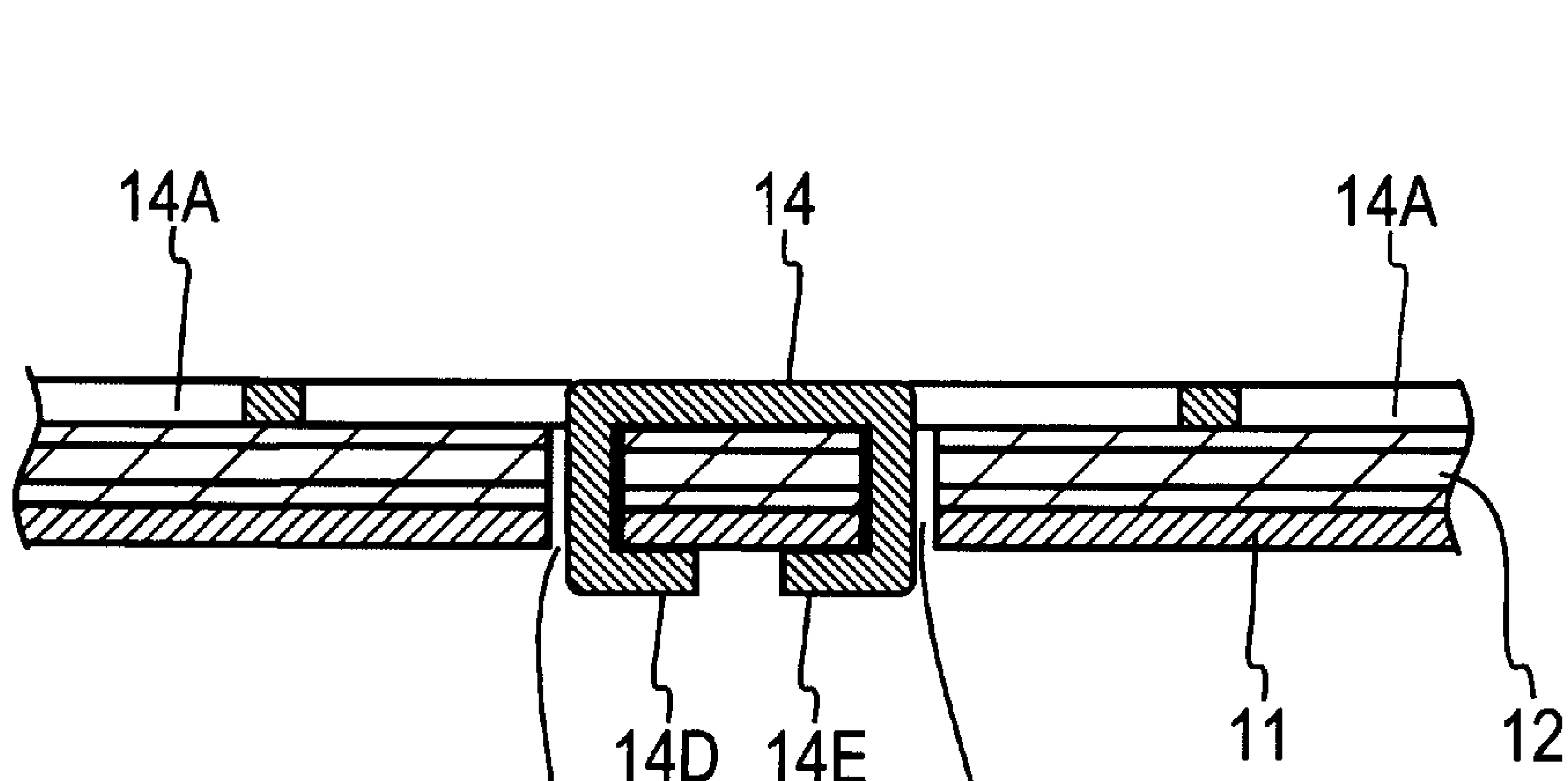
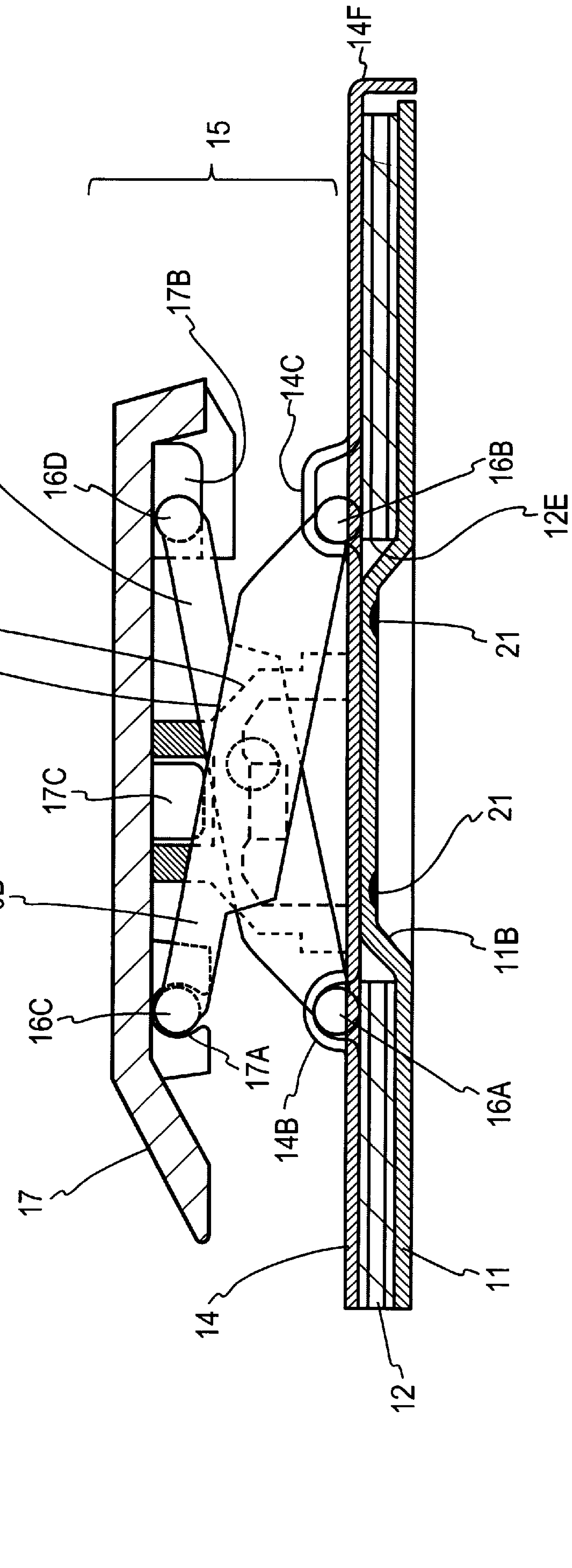

14A
14
14A
14D
14E
11
12
SL
SL

FIG. 11


14F
15
17B
14C
6A
16D
18
18B
18A
16B
12E
21
17C
21
6B
11B
16C
17A
14B
16A
17
14
11
12

KEYBOARD

BACKGROUND OF THE INVENTION

The present invention relates to a keyboard for use as an input device of a computer and other similar devices and, more particularly, to a novel keyboard structure that achieves the low profile and the light weight.

FIG. **1** shows a conventional keyboard structure, which is identical with that proposed by the applicant of this application in Japanese Patent Application Laid-Open Gazette No. 288639/99 entitled "Keyboard Switch."

A description will be given first, with reference to FIGS. **1** and **2**, of the prior art example. The illustrated keyboard is composed of a keyboard substrate **11**, a membrane switch sheet **12**, a keyboard frame **14** and an actuator **15**. The substrate **11** and the frame **14** are each made of a metal sheet. The membrane switch sheet **12** is sandwiched between the substrate **11** and the frame **14** to provide rigidity in the membrane switch sheet **12** and hold it flat.

The membrane switch sheet **12** in this example is shown to be a laminated structure of formed a pattern sheet **12-1** and an insulating sheet **12-2**. On the top of the pattern sheet **12-1** there are deposited contact patterns **12**A and **12**B forming a switch **12**S and a wiring pattern (not shown) for detecting the conduction/nonconduction of electricity between the contact patterns **12**A and **12**B. In the insulating sheet **12-2** overlying the pattern sheet **12-1** there is made an opening **12**C through which the contact patterns **12**A and **12**B and their surrounding areas are exposed. The pattern sheet **12-1** and the insulating sheet **12-2** are sandwiched between the substrate **11** and the frame **14** with the exposed surface of the insulating sheet **12-2** held upward.

In the frame **14** there is also formed an opening **14**A at the position corresponding to the opening **12**C made in the membrane switch sheet **12**. Through these openings **14**A and **12**C a conduction part **18**C projecting downward from the actuator **15** makes contact with the contact patterns **12**A and **12**B to establish electric connections between them.

The actuator **15** in this example comprises pairs of first and second links **6**A and **6**B forming a pantographic lifting or support frame as depicted in FIG. **2**A; a keytop **17** (see FIG. **2**B) mounted atop the pair of links **6**A and **6**B; and a tactile-response collapsible rubber dome **18** which, upon depression of the keytop **17**, allows the conduction part **18**C to move down into contact with the contact patterns **12**A and **12**B and, upon removal of the downward force applied to the keytop **17**, restores the keytop **17** to the position of its top dead center.

The rubber dome **18** is composed of: a cylindrical portion **18**A of a relatively large diameter that encompasses the contact patterns **12**A and **12**B; and a dome portion **18**B with which the cylindrical portion **18**A is capped. On the ceiling of the dome portion **18**B there is protrusively provided the conduction part **18**C having a flat lower end face. When a downward force is applied to the roof of the dome portion **18**B through the keytop **17**, the dome portion **18**B becomes elastically deformed, bringing down the conduction part **18**C. Incidentally, when the dome portion **18**B is deformed to some extent, its reaction force sharply decreases due to its oilcan phenomenon, providing tactile feedback to the keytop **17** being depressed.

Reference numerals **14**B and **14**C respectively denote a pair of leg rotary shaft bearings and a pair of slide shaft bearings both formed by drawing the frame **14**. The pair of leg rotary shaft bearings **14**B rotatably receives leg rotary shafts **16**A that extend outwardly from the lower end portions of the second links **6**A at right angles thereto. The pair of leg slide shaft bearings **14**C receives leg slide shafts **16**A that similarly extend outwardly from the lower end portions of the second links **6**A at right angles thereto, the leg slide shafts **16**A being slidable parallel to the frame surface. Likewise, a pair of rotary bearings **17**A formed on the underside of the keytop **17** rotatably receives first coupling rod **16**C extending between top end portions of the pair of first links **6**B. And, a pair of slide bearings **17**B on the underside of the keytop **17** receives keytop support sliding shafts **16**D protrusively provided on the inner side surfaces of top end portions of the pair of first links **6**B, the sliding shafts **16**D being slidable parallel to the underside of the keytop **17**. The links **6**A and **6**B, the bearings **14**B, **14**C, **17**A and **17**B, and the keytop **17** constitute the pantographic support frame.

In this example, the substrate **11** and the frame **24** are fixedly joined together by: forming bumps **11**A in the substrate **11** by stamping; inserting the bumps **11**A through through holes **12**D in the membrane switch sheet **12** into contact with the underside of the frame **14**; and spot-welding the substrate **11** and the frame **14** at top surfaces or crests **19** of the bumps **11**A. That is, the bumps **11**A and the through holes **12**D are provided at plural places in the substrate **11** and in the membrane switch sheet **12**, respectively, so that the substrate **11** and the frame **14** are welded together at the plural places.

The above conventional keyboard uses an aluminum sheet for the substrate **11** and a stainless steel sheet for the frame **14**. Before the stainless steel sheet came into use as the frame **14**, a thick resin sheet had been used. The use of the thick resin sheet, however, inevitably increases the overall keyboard thickness. The use of the stainless steel sheet in place of the resin sheet permits reduction of the overall keyboard thickness. Because of its high specific gravity, however, the stainless steel sheet increases the overall weight of the keyboard.

Further reduction of the keyboard thickness and weight could be achieved by use of: a single-sheet keyboard structure in which the membrane switch sheet **12** is deposited all over the substrate **11** as of aluminum low in specific gravity and the actuator **15** is mounted directly on the top of the membrane switch sheet **12**; or a two-sheet keyboard structure in which in which the membrane switch sheet **12** is sandwiched between the substrate **11** and the frame **14** both of which are thin aluminum sheets (for example, 0.2 to 0.3 mm thick).

The present inventor studied which of the one- and two-sheet keyboard structures would be mechanically stronger. The following is cross-sectional secondary moments I_1 and I_2 of aluminum sheets with a length b and thicknesses t_1=0.6 mm and t_2=0.5 mm, respectively, as depicted in FIGS. **3**A and **3**B and the cross-sectional secondary moment I_3 of a laminated member of two aluminum sheets with the length b and thicknesses t_3=0.3 mm and t_4=0.2 mm, respectively, as depicted in FIG. **3**C.

$$I_1=(b/12)(0.6^3)=0.018b$$

$$I_2=(b/12)(0.5^3)=0.010b$$

$$I_3=(b/12)(0.8^3-0.3^3)=0.04b$$

The cross-sectional secondary moment I_3 of the laminated structure is about twice larger than the cross-sectional secondary moment I_1 of the single-sheet structure of the thickness t_1=0.6 mm and approximately four times larger than in the case of the single-sheet structure of the thickness t_2=0.5 mm.

In the case of the two-sheet structure, although each sheet is as thin as around 0.2 to 0.3 mm, the cross-sectional secondary moment is I_3=0.04b about twice larger than in the case of the single-sheet structure with t_1=0.6 mm and about four times larger than in the case of the single-sheet structure with t_2=0.5 mm. This suggests that the two-sheet structure is greater in rigidity than the single-sheet structures. Accordingly, the two-sheet keyboard structure will achieve the low profile and light weight.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a two-sheet-structured keyboard of great rigidity.

The keyboard according to the present invention comprises:

- a membrane switch sheet having switch portions arranged thereon in matrix form and through holes made therein in correspondence to the arrangement of keys, each of said switch portions having a pair of contact patterns;
- a keyboard frame formed by a thin sheet of aluminum that has openings made therein opposite said switch portions, said keyboard frame being laminated on the top of said membrane switch sheet to provide therein rigidity;
- a keyboard substrate formed by a thin sheet of aluminum that has a plurality of trapezoidal bumps formed by stamping for engagement with said through holes, said keyboard substrate being laminated on the underside of said membrane switch sheet with said membrane switch sheet sandwiched therebetween, and said plurality of trapezoidal bumps being welded to said keyboard frame; and
- an actuator mounted above each of said opening portions of said keyboard frame to make and break each of said switch portions in response to the depression of a keytop.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram, partly in section, depicting a prior art example;

FIG. **2**A is a perspective view of a pantographic support frame used in the FIG. **2** example;

FIG. **2**B is a perspective view of a keytop used in the FIG. **1** example;

FIG. **3**A is sectional view of a reinforcement member using one plate of a certain thickness;

FIG. **3**B is sectional view of a reinforcement member using one plate of another thickness;

FIG. **3**C is sectional view of a reinforcement member using two plates of different thicknesses;

FIG. **4** is a sectional view taken on the line **4**—**4** in FIG. **5**, for explaining an embodiment of the present invention;

FIG. **5** is an enlarged bottom view of the FIG. **4** embodiment;

FIG. **6** is an enlarged sectional view taken on the line **6**—**6** in FIG. **5**;

FIG. **7** is an enlarged sectional view illustrating a modification of the cross-section along the line **4**—**4** in FIG. **5**;

FIG. **8** is an enlarged bottom view of the keyboard structure according to the present invention, for explaining other structural features;

FIG. **9** is an enlarged sectional view taken on the line **9**—**9** in FIG. **8**;

FIG. **10** is a sectional view showing a modification of the cross-section depicted in FIG. **9**; and

FIG. **11** is a diagram, partly in section, illustrating another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A description will be given, with reference to FIGS. **4** to **7**, of an embodiment of the keyboard according to the present invention. FIG. **4** is a sectional view taken on the line **4**—**4** in FIG. **5**. The keyboard according to the present invention is provided with: the keyboard substrate **11** and the keyboard frame **14** between which the membrane switch sheet **12** for ON/OFF switching operation is sandwiched to provide rigidity in the membrane switch sheet **12** as described previously in respect of the FIG. **1** prior art example; and the actuators **15** each of which applies pressure through one of the openings **14**A (see FIG. **5**) to the membrane switch sheet **12** to cause it to perform an ON/OFF switching operation.

In this embodiment, the substrate **11** and the frame **14** are both formed by aluminum thin sheets with a view to reducing the total weight of the keyboard structure. At the same time, to compensate for the decreased strength of the keyboard caused by the use of the thin aluminum sheets, through holes **12**E and **12**F are made in the membrane switch sheet **12** adjacent the substantially rectangular openings **14**A made in the frame **14**, and trapezoidal bumps or protrusions **11**B and **11**C are formed by stamping the substrate **11** in opposing relation to the through holes **12**E and **12**F. The trapezoidal bumps **11**B are square in plan configuration, whereas the bumps **11**C are elliptic in plan configuration. The heights of the trapezoidal bumps **11**B and **11**C are nearly equal to the thickness of the membrane switch sheet **12**. FIG. **5** is a view of the keyboard from its bottom side (from the substrate **11** side). FIG. **6** is a sectional view taken along the line **6**—**6** in FIG. **5**. Incidentally, the bump **11**A fitted in the through hole **12**D in FIG. **5** has the same configuration as that of the bump **11**A fitted in the through hole **12**D described previously with reference to FIG. **1**.

In FIG. **5**, the direction of the line **6**—**6** will hereinafter be referred to as a row direction and the direction of the line **4**—**4** as an inter-row direction. The arrangement of the keytops **17** is indicated by the two-dot chain line. The openings **14**A are formed in plural rows in a staggered configuration in correspondence to the arrangement of the actuators **15**. The through holes **12**E are made in the membrane switch sheet **12** between adjacent openings **14**A in the same row, and the through holes **12**F are made in the membrane switch sheet **12** between adjacent rows of openings **14**A. Accordingly, the square trapezoidal bumps **11**B are fitted in the through holes **12**E formed between the openings **14**A arranged in the row direction, and the elliptic trapezoidal bumps **11**C and the circular trapezoidal bumps **11**A are formed between the rows of openings **14**A.

The trapezoidal bumps **11**B and **1**C are called trapezoidal since their top surfaces are formed flat. These trapezoidal bumps **11**B and **11**C are fitted in the through holes **12**E and **12**F made in the membrane switch sheet **12** with their flat top surfaces in contact with the back of the frame **14**, and the substrate **11** and the frame **14** are joined together by spot-welding them at one or more points of their contact portions. Reference numeral **21** denotes welded portions (by spot-welding that uses laser light, for instance). In the FIG. **5** embodiment the square trapezoidal bumps **11**B are each spot-welded at four corners to the frame **14**, whereas the elliptic trapezoidal bumps **11**C are each spot-welded at two points to the frame **14**. FIG. **7** shows the case where the bumps **11**C are each welded at one point. In this instance, it is desirable to provide sufficient strength at the welded joint by welding over a relatively wide area. Such a single-spot-welding scheme permits substantial reduction in the number of welded joints, hence decreasing the number of manufacturing steps involved.

With the structure in which the substrate **11** and the frame **14** are welded to each other at places between adjacent openings **14**A in each row and between the rows of openings **14**A, it is possible to firmly join the substrate **11** and the frame **14**, providing increased strength in the keyboard. In particular, the formation of the openings **14**A in the frame **14** decreases its strength around the openings **14**A, but the decrease in the strength of the frame **14** can be suppressed by welding it to the substrate **11** at the points adjoining the openings **14**A. This constitutes a major factor for succeeding in the production of a great-rigidity keyboard.

While the FIG. **4** embodiment has been described to use the pantograph structure for the actuator **15**, the present invention is not limited specifically to such a structure. As will be easily seen from the above, the present invention is applicable not only with the membrane switch sheet **12** of the two-sheet configuration in which the contact patterns **12**A and **12**B are exposed as depicted in FIG. **1** but also with a membrane switch sheet of a three-sheet configuration in which three insulating sheets are laminated so that the contact patterns are not exposed.

Turning next to FIGS. **8** and **9**, another embodiment of the present invention will be described below. FIG. **9** is an enlarged sectional view taken along the line **9**—**9** in FIG. **8**. This embodiment uses aluminum thin sheets for the keyboard substrate **11** and the keyboard frame **14** to achieve weight reduction of the keyboard. Further, some of the trapezoidal bumps or protrusions **11**B formed by stamping the substrate **11** are not welded to the frame **14** in the through holes **12**E made in the membrane switch sheet **12**, but instead a pair of parallel rectangular lugs **14**D and **14**E are downturned from the frame **14** in the area just above each through hole **12**E, and inserted through a pair of parallel slits SL made in the top of the trapezoidal bump **11**B, then the lower ends of the downturned lugs **14**D and **14**E projecting beyond the underside of the bump **11**B are bent parallel thereto so that the lugs **14**E and **14**D are swaged to the bump **11**B. This is intended to provide increased rigidity in the substrate **11** and the frame **14** joined together.

It is desirable that the number of such swaged structures as shown in FIGS. **8** and **9** be in the range of 10 to 20% of the trapezoidal bumps **11**B, and the swaged structures are uniformly spread all over the keyboard. The swaged structures provide increased rigidity in the keyboard formed by the substrate **11**, the membrane switch sheet **12** and the frame **14**. Since the swaged structures afford rigidity particularly against bending about the direction perpendicular to the line **9**—**9** in FIG. **8**, the rigidity of the keyboard can be further increased by uniformly arranging the pairs of lugs **14**D and **14**E so that the lugs **14**A and **14**E are bent at right angles to those in adjacent trapezoidal bumps **11**B. Furthermore, by selecting the thickness of the frame **14** to be equal to or smaller than the depth of a recess **11**F defined on the back side of the bump **11**B, the lugs **14**D and **14**E do not project beyond the underside of the plate **11** as shown in FIG. **9**—this enables the realization of a low-profile keyboard.

In the embodiments of FIGS. **8** and **9**, the slits SL are made in each trapezoidal bump **11**B, and the lugs **14**D and **14**F downturned from the frame **14** are swaged thereto in the opening **14**E made therein. It is also possible, however, to employ such a structure as depicted in FIG. **10**, in which the trapezoidal bumps **11**B in the substrate **11** and the openings **12**F in the membrane switch sheet **12** are not formed between some of adjacent openings **14**A and the openings **12**F but instead the lugs **14**D and **14**E are swaged to the substrate **11** after being inserted through slits SL made in the substrate **11** and the membrane switch sheet **12**. In this case, however, the bent portions of the lugs **14**A and **14**E project out beyond the back of the substrate **11**.

FIG. **11** illustrates another embodiment of the keyboard according to the present invention. In this embodiment the keyboard substrate **11** and the keyboard frame **14** are both formed by aluminum thin sheets so as to reduce the thickness and weight of the keyboard, and with a view to providing increased rigidity in the keyboard, the marginal portion of the frame **14** is downturned at right angles to form a bent portion **14**F. In this instance, by extending the bent portion **14**F as long as possible along the entire thickness of the substrate **11**, the strength of the bent portion **14**F is maximized to provide greater rigidity of the frame **14**. With the bent portion **14**F all around the frame **14**, it is possible to increase the rigidity of the frame **14** and hence provide a keyboard of increased rigidity accordingly.

In each of the embodiments described above, the use of aluminum thin sheets for the key board substrate **11** and the keyboard frame **14** permits reduction of the thickness of the keyboard with the substrate **11**, the membrane switch sheet **12** and the frame **14** laminated. Incidentally, by using a 0.2 mm thick aluminum sheet for the substrate **11**, a 0.3 mm thick aluminum sheet for the frame **14** and a 0.3 mm thick membrane sheet, the total thickness of the keyboard can be made as small as 0.8 mm.

In addition, the use of the thin aluminum sheet for the frame **14** permits reduction of the keyboard weight by approximately 20 to 30% as compared with a keyboard using a stainless steel plate.

Besides, even if the frame **14** is formed by an aluminum thin sheet with a view to weight reduction, the rigidity of the keyboard can be increased as described above by an arbitrary combination of:

(a) the structure in which the top surfaces of the trapezoidal bumps or protrusions **11**B and **11**C are spot-welded at one or more points to the back of the frame **14**;

(b) the structure in which the frame **14** and the substrate **11** are joined together by swaging the lugs **14**D and **14**E to the substrate **11**; and

(c) the structure in which the marginal portion of the frame **14** is downturned to form the bent portion **14**.

Accordingly, the present invention provides lightweight, low-profile and highly rigid keyboard, and hence the invention is of great utility when employed in practice.

Moreover, by performing the spot-welding step after joining the frame **14** and the substrate **11** by swaging the lugs **14**D and **14**E to the substrate **11**, the positioning of the membrane switch sheet **12** and the substrate **11** relative to each other is completed with the swaging step—this allows ease in the subsequent spot-welding step.

EFFECT OF THE INVENTION

As described above, the keyboard according to the present invention using aluminum for the keyboard frame **14** can be made lightweight as compared with a keyboard using a frame made of stainless steel. In particular, by making through holes in the membrane switch sheet at plural positions, then inserting through the through holes trapezoidal bumps formed by stamping of the substrate, and then welding the bumps to the frame, the substrate and the frame can be firmly joined together to provide great rigidity. This enables the realization of a lightweight, great-rigidity keyboard.

With the welded point between adjacent openings in the row direction or between rows of the openings made in the frame, it is possible to reinforce strength-decreased portions of the frame between the openings. This provides increased strength of the frame and hence further increases the strength of the laminated substrate and frame structure.

Furthermore, the top surfaces of the trapezoidal bumps or protrusions formed by stamping the frame are disposed in surface-to-surface contact relationship with the frame and the surface-contact portion is spot-welded at one or more points, by which the substrate and the frame can be held parallel to each other. The spot-welding at plural points enables the substrate and the frame to be firmly jointed together. The spot-welding does not deform the surrounding portion, in particular, the frame that is ultimately used as the keyboard surface; therefore, a high-quality keyboard can be obtained.

With the structure in which the lugs extended from the frame are projected out onto the underside of the trapezoidal bump through the through holes in the membrane switch sheet and the substrate and the projected end portions of the lugs are bent along the underside of the substrate to swage thereto the frame, the substrate and the frame can be joined together more firmly. In addition, bending the lugs provides increased rigidity in the direction perpendicular to that in which the lugs are bent. This ensures fabrication of a lightweight but great-rigidity keyboard.

Moreover, since the lugs bent on the back of the substrate are received in the recess defined by the underside of the trapezoidal bump, the lugs do not project out beyond the back of the keyboard substrate. Accordingly, the lug swaging structure does not constitute an obstacle to the realization of a low-profile keyboard.

Besides, the bent portion downturned from the keyboard frame all around it provides increased rigidity in the entire frame structure, thereby preventing the keyboard from bending or deformation.

What is claimed is:

1. A keyboard comprising:

a membrane switch sheet having switch portions arranged thereon in matrix form and through holes made therein in correspondence to the arrangement of keys, each of said switch portions having a pair of contact patterns;

a keyboard frame formed by a thin sheet of aluminum that has openings made therein opposite said switch portions, said keyboard frame being laminated on the top of said membrane switch sheet to provide therein rigidity;

a keyboard substrate formed by a thin sheet of aluminum that has a plurality of trapezoidal bumps formed by stamping for engagement with said through holes, said keyboard substrate being laminated on the underside of said membrane switch sheet with said membrane switch sheet sandwiched between said keyboard substrate and said keyboard frame, and said plurality of trapezoidal bumps being welded to said keyboard frame; and

an actuator mounted above each of said opening portions of said keyboard frame to make and break each of said switch portions in response to the depression of a keytop.

2. The keyboard of claim **1**, wherein said openings are made in plural rows all over said keyboard frame and said through holes are each made in said membrane switch sheet in opposing relation to the area between adjacent ones of said openings in each row direction.

3. The keyboard of claim **1**, wherein said openings are made in plural rows all over said keyboard frame and said through holes are each made in said membrane switch sheet in opposing relation to the area between adjacent rows of said openings.

4. The keyboard of any one of claims **1** to **3**, wherein two or more of said trapezoidal bumps have flat top surfaces for surface-to-surface contact with the underside of said keyboard frame, said two or more of trapezoidal bumps having their flat top surfaces spot-welded at one or more points to said keyboard frame.

5. The keyboard of any one of claims **1** to **3**, wherein the other remaining trapezoidal bumps each have made therein at least one slit, and lugs extended from said keyboard frame toward said keyboard substrate are each inserted through one of said at least one slit onto the back of one of said trapezoidal bumps, the projecting end portions of said each lug being bent to join said keyboard frame and said keyboard substrate together.

6. The keyboard of claim **5**, wherein the thickness of said each lug is accommodated by a recess defined by the underside of one of said trapezoidal bumps.

7. The keyboard of claim **5**, wherein said at least one slit in each of said trapezoidal bumps is made at right angles to said at least one slit in each of adjacent ones of said trapezoidal bumps.

8. The keyboard of claim **5**, wherein said trapezoidal bumps have two parallel slits for the insertion therethrough of two lugs extended from said keyboard frame, said the projected end portions of said two lugs being swaged to said keyboard substrate.

9. The keyboard of any one of claims **1** to **3**, wherein said membrane switch sheet and said keyboard substrate each have plural slits extending therethrough and plural lugs extended from said keyboard frame toward said keyboard substrate are inserted through said plural slits onto the back of said keyboard substrate, the projecting end portions of said plural lugs being bent parallel to the back of said keyboard substrate to firmly join said keyboard frame and said keyboard substrate together.

10. The keyboard of any one of claims **1** to **3**, wherein said keyboard frame has its marginal portion bent all around it toward said keyboard substrate.

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